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Report of the PSARC Invertebrate Subcommittee Meeting January 25-28, 1999

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Pacific Scientific Advice Review Committee (PSARC)
Pacific Biological Station
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SUMMARY

The PSARC Invertebrate Subcommittee met January 25-28, 1999 at the Pacific Biological Station in Nanaimo. The Subcommittee reviewed eight Working Papers, six Fishery Updates, and four Stock Status Reports. External participants from Parks Canada and industry organizations attended the meeting.

Working Papers I99-1, I99-3: Phase 0 Assessments

Working Papers representing Phase 0 assessments were completed for two species: California mussel (I99-1) and goose barnacle (I99-3). These working papers represent the preliminary phase to assemble all available information on the biology of the target species, and similar species, related to the scientific information requirements for precautionary management strategies (Perry 1996).

The working papers on California mussels and goose barnacles identified the importance of these animals to the ecology of high energy wave-swept rocky shores. A more precautionary approach was recommended for the existing goose barnacle fishery and a very cautious approach was suggested for any proposed development of the California mussel fishery.

Working Paper I99-2: Stock assessment and management frameworks for the proposed fishery for sea mussels *(Mytilus californianus)* in British Columbia

The paper presented a thorough review of sea mussel biology, and programs to assess, manage and monitor proposed sea mussel fisheries. The Subcommittee recommends that a very cautious approach be taken with any proposed sea mussel fishery.

Working Paper I99-4: Evaluation of a new assessment and management framework for West Coast shrimp stocks

This paper considers what assessment methods should be used to reliably estimate shrimp biomass. These estimates are required to ensure conservation and to develop sustainable fisheries. The Subcommittee recognized that evaluation of the current strategy is difficult following one year of data collection. Therefore, the Subcommittee supports continuance of surveys undertaken in 1998.

Working Paper I99-5: Halibut by-catch in the British Columbia shrimp trawl fishery

Since 1996, at-sea observers have collected information on the by-catch of

halibut in the shrimp trawl fisheries in British Columbia. Over a three-year time span very few halibut have been observed in the B.C. shrimp trawl fisheries. From these observations the Subcommittee felt that halibut by-catch appears not to be a significant issue in B.C. shrimp trawl fisheries. The Subcommittee recommended examination of the effectiveness of exclusion devices in reducing by-catch in shrimp trawls.

Working Paper I99-6: Implications on assessment of the British Columbia prawn populations with the adoption of a quota management system

Industry and fisheries managers have been considering adopting a quota type management system for the prawn fishery in British Columbia. The paper concluded that entering into a quota system for prawns would be a very expensive and time-consuming undertaking, considering the data and analytical requirements. The Subcommittee supported this conclusion and does not recommend the implementation of a quota program at this time due to expense and limited data availability.

Working Paper I99-7: Review of the fishery and assessment of green sea urchin stocks in British Columbia.

The green urchin fishery in B.C. developed rapidly from 1987 to 1991, and peaked in 1992 with landings of 1,042 t. Declining landings and catch per unit of effort followed and management restrictions were implemented in 1992. In 1995, an individual quota system with dockside validation was implemented. In 1997/98, coastwide landings (all in the South Coast) were 160 t, approximately equal to the quota. The Subcommittee recommended that yield options for the 1999-2000 fishing season by management area should be conservative and maintained well below the estimated MSY levels.

Working Paper I99-8: Review of status of Northern, or Pinto abalone, *Haliotis kamtschatkana*, in Canada

The author reviewed the status of Northern abalone for the purpose of recommending a risk category for consideration by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The Subcommittee concluded that the information and the analysis presented in the paper did not provide a scientific basis to support the author's recommendations. However, the Subcommittee reiterated its grave concern for abalone populations. Despite fishery closure since 1990 there is no evidence of rebuilding of abalone stocks.

Fishery Updates

Fisheries Management staff, in consultation with Conservation and Protection and the Stock Assessment Division, prepare fishery updates. The updates provide summaries of commercial fishery performance, including significant

management, enforcement, and stock assessment activities on an annual basis. The updates provide the opportunity to identify high priority issues that affect assessment and conservation concerns.

The Subcommittee recommended that the format for fishery updates be revised to parallel the framework for Integrated Fisheries Management Plans (IFMP's) to reduce duplication of effort and assist in the development of IFMP's.

The subcommittee noted that the quality of goose barnacle harvest data has continued to decline.

The shrimp trawl fishery continues with the active management that began in 1997. Assessment surveys and in-season management actions require considerable effort. Precautionary quotas continue as the fishery remains data limited and likely will for many years.

The possibility of establishing individual vessel-based quotas in the shrimp by trap (prawn) fishery was addressed in working paper I99-6. Additional concerns for the fishery include:

- the potential impacts of the growing recreational fishery;
- the impacts of multiple trap hauling in a single day;
- the combined effects of a weak Japanese economy and a short fishing season, and;
- the possible options for funding the fishery after 2001 when cost recovery will no longer be available through Treasury Board submissions.

The priority issue of evaluating the impacts of commercial fisheries on the ability of First Nations to access red sea urchins for food, social and ceremonial purposes was recognized.

The first significant landings of neon flying squid were reported in 1998 after a slow beginning to this new fishery.

INTRODUCTION

The Subcommittee Chair, Ivan Winther, opened the meeting by welcoming the participants. During the introductory remarks the objectives of the meeting were reviewed, and the Subcommittee accepted the meeting agenda (Appendix 1).

The Subcommittee reviewed eight working papers, six fishery updates and four stock status reports. Working Paper titles, authors and reviewers are listed in Appendix 2. A ninth working paper was withdrawn just prior to presentation to the Subcommittee, after the authors had received the reviews. The Subcommittee provided comments on stock status reports for goose barnacles,

shrimp, prawns and Dungeness crab. These reports remain drafts for future completion after incorporating revisions suggested at the meeting.

The Subcommittee noted that the first external participants to attend the Invertebrate Subcommittee were present at this meeting. Heather Holmes (Pacific Rim National Park Reserve) and Norm Sloan (Gwaii Haanas National Park Reserve) attended as external participants. Tom Orr and Guy Johnson (prawn sectoral committee representatives) attended the presentations of the Prawn Fishery Update and working paper I99-6 as observers. Lorne Clayton (facilitator, Pacific Coast Shrimpers' Cooperative Association) attended the presentations of the Shrimp Trawl Fishery Update and working papers I99-4 and I99-5 as an external participant. A list of meeting participants is included as Appendix 3.

WORKING PAPER SUMMARIES, REVIEWS AND DISCUSSION

I99-1 A review of California mussel (Mytilus californianus) fisheries biology and fisheries programs.

D. Schmidt **Accepted subject to revisions**

Summary

A review of the basic biology of California mussels *(Mytilus californianus)* as well as, a review of the fisheries of California mussels in British Columbia and the rest of the world was presented. The review was based upon previous scientific works in literature reviews, surveys, and technical reports. Where information was lacking, an attempt was made to fill in the gaps with information about closely related species *(Mytilus edulis)*. Through the review, information shortfalls were identified, and recommendations for additional information requirements for stock assessments and management plans were suggested based on practices in other fisheries.

Reviewers' Comments

Reviewer 1 felt that although the literature review was fairly extensive some key references were missed. Reviewer 1 provided eight references to the author. The author's suggestion that a fishery on California mussels was economically supported "as existing fisheries cannot supply the increasing demand for mussels" was considered incautious by Reviewer 1. Reviewer 1 cited a similar situation in clams where littlenecks receive a lower value even though the manila market is not fully supplied.

Reviewer 1 suggested further discussion of the potential dangers of mussel bed loss due to wave scouring and battering by debris in winter storms especially in the context of how this might affect the mussel beds after they are altered in the

fishery.

Reviewer 1 pointed out that the author only considered an estimate of initial biomass to determine conservative harvest levels. The author has not considered direct fishery controls such as quotas or TAC's. Reviewer 1 was critical of the management scheme proposed by the author using length frequency distributions as an indication of how the population is doing under the harvest regime. This method would not detect serial depletions of mussel beds.

Reviewer 1 suggested that the condition factor presented was unlikely to provide meaningful information on mussel condition, as it was a wet weight to length ratio, rather than the usual dried meat weight to shell volume ratio.

Reviewer 1 found the Oregon example troubling as it presents the inability of mussel populations to compensate for fishery removals. Reviewer 1 notes that compensation in B.C. stocks might be even slower than Oregon if there is a latitudinal trend in growth rates.

Reviewer 1 suggested several editorial changes to the text, figures and tables, particularly in the life history section. A marked manuscript was provided to the author.

Reviewer 2 provided extensive editorial and organisational suggestions for the paper. Reviewer 2 suggested that the tone of the working paper be modified from that of information for "establishing a fishery" to information for "consideration of the development of a fishery." Reviewer 2 also noted that the paper was not complete in its review of the literature and provided some references in addition to those noted by Reviewer 1.

Reviewer 2 questioned the demand for California mussels and suggested the author provide references to qualify the market demand suggested in the paper. Reviewer 2 also requested information on the market itself as to location, species, quantity and value. Reviewer 2 noted that First Nations use of California mussels should be considered in the paper, as they were a traditional food.

Reviewer 2 commented that since key biological information was missing on the species (such as growth and natural mortality) that the discussion of management options in the paper was premature. Reviewer 2 suggested that the focus should be placed on identifying the information requirements and gathering baseline data.

Reviewer 2 suggested the subcommittee agree on one common name for *M. californianus* from the two working papers, either sea mussels or California mussels.

Subcommittee Discussion

The author was commended for a paper well written and presented, especially considering he has not taken part in the PSARC process before. The author agreed with the reviewers' comments and will make the necessary changes.

The appropriate content for a phase 0 paper was discussed. The subcommittee suggested that the paper make more reference to the reasons for the paper. Guidelines for phase 0 papers are required but the subcommittee noted that this requirement would soon be met by the publication of some phase 0 papers in a technical report that will include guidelines in the introduction.

The subcommittee noted that there is a mussel fishery in British Columbia, not indicated in the paper, which is used for monitoring biotoxins for other bivalve fisheries. Data from this fishery should be documented.

Mussels are considered a high-risk food product because of their quick uptake of biotoxins. This may limit their development of a food fishery due to the high costs of monitoring.

The subcommittee notes the Oregon fishery could not sustain a harvest, however, there is insufficient documentation of that fishery to indicate why.

The subcommittee recognizes the lack of information on the California mussel and notes the need for more data; examples include sustainable harvest levels and fecundity versus recruitment.

Recommendations

The subcommittee accepted the paper with revisions. The subcommittee recommended monitoring the harvest and assessing the data from the Biotoxin Monitoring Program.

I99-2 Stock assessment and management frameworks for the proposed fishery for sea mussels (*Mytilus californianus*) in British Columbia.

G.E. Gillespie **Accepted subject to revisions**

Summary

Sea mussels (*Mytilus californianus*) are the largest species of mytilid mussel. They are found only on the West Coast of North America, and range from Baja California to Alaska. Sea mussels form dense beds, generally in the intertidal zone of exposed rocky shores. Sea mussels spawn throughout the year, with peaks in activity in the spring and fall. Fertilization is external, and pelagic larvae may spend 3-5 weeks drifting planktonically before settling to adult habitat. Growth rates are variable, depending on availability of food, intertidal elevation,

temperature and mussel density. Sea mussels can grow to approximately 270 mm in length, and may live 50-100 years. Size at maturity is approximately 70 mm in length. Sea mussels are filter feeders, and are in turn preyed upon by sea stars, whelks, crabs, fish, birds and marine mammals.

Mussel beds are highly structured, and provide habitat for nearly 300 other species. If greatly disturbed or destroyed, mussel beds require many years (5-100+) to recover to the climax community. Rate of recovery is dependent on size of the disturbance, season of disturbance, intertidal elevation, substrate angle and intensity of larval recruitment.

A small fishery for sea mussels existed in Oregon from 1979-1997. Landings peaked in 1989 at nearly 30 t, but have since declined to <1 t. Reasons for the decline are unknown, but may include overharvest.

Programs to assess, manage and monitor proposed sea mussel fisheries were presented and evaluated. Because of the longevity of sea mussels, and the sensitivity of the mussel bed community to disturbance, very low harvest rates and specialized means of responsible harvesting were discussed. A preliminary survey protocol and suggestions for collecting fishery-dependent and fishery-independent information were provided.

Reviewers' Comments

Reviewer 1 was complimentary and commented that based on California mussels' slow growth and their value in providing structure for other species, there will never be a large sustainable fishery. Reviewer 1 provided a few minor editorial comments and noted that the career span of managers and scientists is much less than the time it would take to monitor the long term effects of harvesting. Reviewer 1 lauded the use of the phased approach in considering all of the scientific evidence available to make management decisions.

Reviewer 2 commended the author on an excellent review and suggested it be published as a Manuscript or Technical report so that it is readily available. Reviewer 2 noted that there was a small commercial fishery on California mussels in the 1960's or early 1970's that failed because of the economics and poor quality product (local mussels tend to have many small "pearls"). Reviewer 2 provided some minor editorial comments. Reviewer 2 noted that obtaining the biological information on California mussels represented a great deal of work and felt that a fishery for the species could not warrant the effort involved. Reviewer 2 questioned whether this level of biological information was available for the species commercially harvested at present.

Subcommittee Discussion

The Subcommittee appreciates all the work and effort that went into this paper. The Subcommittee questioned the reasons for considering a commercial food fishery. It was noted that the demand for mussels for biotoxin monitoring is likely to increase as other bivalve fisheries expand.

The Subcommittee cautioned that using minimum size limits alone, based on size at first spawning, might not be conservative given the longevity of the species.

It was stressed that California mussels are a keystone species that provide a habitat structure for up to 300 associated species. Harvests may have significant ecological impacts on this climax community.

The Subcommittee recognized that this would be an intensely managed fishery, limited to small areas at low harvest rates (1.5 to 2.6%) that would only yield a small return.

Subcommittee Recommendations

The Subcommittee accepted the paper with minor revisions. The Subcommittee recommended:

1. That any phase 1 development of the California mussel fishery must consider the current fishery for biotoxin monitoring.
2. That a very cautious approach be taken with this fishery which takes into account possible ecological impacts to the mussel bed community.
3. Those potential ecological impacts arising from the development of the California mussel fishery be referred to the Habitat Subcommittee of PSARC.

I99-3 A review of the biology and fisheries of goose barnacle (*Pollicipes polymerus* Sowerby, 1833).

R.B. Lauzier **Accepted subject to revisions**

Summary

A review of the biology of goose barnacles (*Pollicipes polymerus* Sowerby, 1833) was presented, based on scientific literature, previous surveys and technical reports. The biological information presented, included: geographic distribution; habitat, ecological relationships and co-occurring species; feeding habits; reproduction; as well as limited growth, age, mortality, recruitment density and biomass information.

A review of the goose barnacle fishery in British Columbia was presented,

showing historical trends in effort and landings, with a peak in the late 1980s, and declining to the low levels of recent years.

Biological information shortfalls were identified, including; detailed distribution of goose barnacle stocks; estimates of biomass; an accurate estimation of proportion of the total stock actually available to the fishery; and the dynamics of recovery following harvesting. Recommendations for additional information requirements for stock assessments include recruitment, age structure and natural mortality.

Concerns expressed by experienced harvesters over the past few years were identified and addressed. Recommendations were made for the continued development of the goose barnacle fishery in a precautionary manner.

Reviewers' Comments

Reviewer 1 provided a number of editorial comments. Reviewer 1 disputed the rostral carinal (RC) length as the best indicator of size because of the range in tissue mass exhibited by goose barnacles of the same RC length and because of the morphological variations possible in the carinal plate. Reviewer 1 questioned whether carinal plates are suitable for aging as they can slough off.

Reviewer 1 found market considerations every bit as important as harvesting considerations for the goose barnacle fishery. Reviewer 1 noted that a key to market acceptance of goose barnacles was the form or shape of the peduncle.

Reviewer 1 was concerned about the use of a generalized mortality model to estimate natural mortality given the limited data.

Reviewer 2 complimented the author on a credible job of compiling the limited amount of information on goose barnacles. Reviewer 2 questioned the continuance of a fishery reportedly worth only $34K annually and noted that even the limited management the fishery currently receives probably costs more than the gross landed value. Reviewer 2 suggested that monies for developing fisheries would be better spent elsewhere.

Reviewer 2 requested a more comprehensive discussion of goose barnacle / California mussel interactions including how fisheries on either species might affect the other. Reviewer 2 had a few editorial comments and some suggestions for additional information.

Subcommittee Discussion

The Subcommittee felt the paper was well written.

The Subcommittee was concerned that the data from the commercial fishery has

deteriorated. The fishery continues to be unregulated.

The Subcommittee discussed the possibility of closing the goose barnacle fishery with potential harvesters licensed with scientific licenses. This was not supported. The Subcommittee discussed options of management and stock assessment of this fishery with participation of the newly reactivated Goose Barnacle Co-operative.

The Subcommittee has the following concerns with the commercial goose barnacle fishery:

- Non-selective harvesting techniques.
- Ecological impacts.
- Impacts on breeding success.
- Discarding of product due to poor harvest techniques and product suitability.
- Poor catch reporting.
- The sustainability of this fishery is unknown.

Subcommittee Recommendations

The Subcommittee accepted the paper with minor revisions. The Subcommittee recommended:

1. Given there are not sufficient data to recommend biologically based management for goose barnacles, more precautionary measures, including new management controls and assessment programs, be considered.
2. That continuation of the goose barnacle fishery must follow the phased approach described in the Pacific Region Policy for New and Developing Fisheries.

I99-4 Evaluation of a new assessment and management framework for West Coast shrimp stocks.

J.A. Boutillier, J.A. Bond and H. Nguyen **Accepted subject to revisions.**

Summary

In response to conservation concerns as a result of recent major shifts of effort into the shrimp trawl fishery, a quota management system for shrimp, incorporating catch ceilings and designated Shrimp Management Areas (SMA), was adopted in 1997. This new system required a different assessment data and information system, including the development of assessment tools that can be used to evaluate the dynamics of the stocks. This paper summarised the stock assessment activities carried out in 1997 and 1998, including both field and analytical assessment methods, identified proposed changes, and discussed what will be required in the future under this new quota management system.

To ensure conservation and to develop appropriate databases to understand the stock dynamics so fisheries can develop in a sustainable manner, there must be a system in place to obtain reliable biomass indices of key stocks. With this aim in mind, a series of area swept trawl surveys were conducted in selected shrimp management areas. Many new areas were surveyed in 1998 and the survey off the West Coast of Vancouver Island was expanded to include Barkley Sound. New surveys completed to the end of October 1998 include Queen Charlotte Sound, Fraser River area, Chatham Sound (portions of Prince Rupert District), Area 9-Inside, Area 12-Inside and Area 12-Outside. The implementation of this program in 1998 was described. The paper detailed the steps, problems encountered, and adjustments made to both the field and the analytical procedures.

This paper evaluated the assessment tools used in 1997 and 1998, discussed the setting of initial catch ceilings through forecasting for surveyed areas, and considered the extrapolation of information from surveyed areas to make inseason adjustments to non-surveyed areas. Recommendations are made for the 1999/2000 fishery. The paper also discusses the management systems implemented in 1998 and makes suggestions for 1999/2000.

The paper noted that we are currently at the first step in a long process required to meet the objectives of conservation and the development of databases required to understand the stock dynamics. Over the long term, the management and assessment systems for these fisheries will undergo a number of changes as information is received on the key issues of biomass estimation, how populations respond to exploitation, and the appropriate management decision rules that should be adopted.

Reviewers' Comments

Reviewer 1 found the approach in the working paper sound and similar to other Pandalid stock assessments actively attempting to improve their advice. Reviewer 1 noted the additional obstacles of several commercial species and the apparently large number of separate stocks. Reviewer 1 suggested including more on the long-term steps to suggest what the final suite of assessment and management tools might look like. Reviewer 1 requested a description of the biological versus logistical basis for choosing the strategies presented.

In considering the many shrimp management areas, Reviewer 1 questioned whether they were a logistical convenience or an attempt to reflect shrimp stocks. Reviewer 1 noted that the key to improvement in management is survey continuity and inter-annual comparability. Reviewer 1 questioned the use of traps in the surveys citing many problems with trap CPUE. Reviewer 1 discussed the problems of comparing CPUE data from surveys and commercial fisheries.

Reviewer 1 provided a number of editorial comments including the suggestion for

a new title (incorporated above).

Reviewer 2 was critical of the organization of the paper and provided a number of editorial suggestions. Reviewer 2 questioned the standardization of effort between vessels on multiple vessel surveys and noted that this feature of the study design presents problems for determining estimates of abundance, variance and confidence intervals. Reviewer 2 questioned whether the data still meets the assumptions required for the analyses, given all the logistical problems encountered. Reviewer 2 requested more explanation of the procedures required to address the field and analytical problems. Reviewer 2 requested clarification on how the initial quotas were set, noting that all were not strictly arbitrary. Reviewer 2 noted that fishery based CPUE should not be used to track population abundance because of problems with hyperstability of CPUE. Reviewer 2 questioned what alternatives are available for shrimp trawl fisheries and how much biological data are required for these alternatives.

Subcommittee Discussion

Subcommittee discussion reflected that, in some instances, particularly in limited areas, populations are probably entrained stocks. The northward shift in strong recruitment off the West Coast of Vancouver Island implies a stock-recruit relationship, expressed over multiple spatial components. In general, however, stock definition is poorly known.

The Subcommittee appreciated comments of an industry-sponsored participant who stated that, in general, industry finds survey design confusing. However, each time the topic is revisited, industry better understands, and begins to accept methods. Systematic design is counterintuitive to fishers, who strive to maximize CPUE, not determine limits of distribution. Industry would like to see development of international standards for assessment and management as they are concerned that shrimp management and assessment may be done better elsewhere. Industry supports development of population indices, and has sought external funding for index surveys and genetic studies.

The Subcommittee discussed at length other potential assessment tools, including CPUE, biological samples and direct surveys of all Shrimp Management Areas. Some members expressed concern that applying information from index areas to adjacent areas might be inappropriate, given the range of species composition in surveyed areas, and felt that alternative strategies should be explored now. However, it is not logistically possible to survey all areas. The Subcommittee recognized that evaluation of the current strategy is difficult following one year of data collection.

Subcommittee Recommendations

1. The Subcommittee accepted the paper subject to recommended revisions.
2. The Subcommittee supported continuance of surveys undertaken this year, with the caveat that selection of survey areas may be an artifact of industry's willingness to participate, and that not all areas surveyed might be appropriate for continuance.
3. Subcommittee recommended that an analysis of the WCVI data series to look at the power or ability of trawl surveys to measure or provide an index of population changes.

I99-5 Halibut by-catch in the British Columbia shrimp trawl fishery.

J.A. Boutillier, J.A. Bond and H. Nguyen **Accepted subject to revisions.**

Summary

Since 1996, at-sea observers have collected information on the by-catch of halibut in the shrimp trawl fisheries in British Columbia. Three shrimp trawling areas were identified as having halibut caught either in the commercial catch or in assessment surveys. These areas include the offshore fisheries off the West Coast of Vancouver Island and in Queen Charlotte Sound, and the nearshore fishery in Chatham Sound. This paper described the by-catch observer program, summarizes data collected on halibut by-catch in these three fisheries since 1996, and provides estimates of the amount of halibut caught as by-catch in the shrimp trawl fisheries in these areas.

In recent years, the number of vessels participating in the shrimp trawl fishery in British Columbia has increased. In addition, the number of vessels exclusively fishing shrimp has also increased. The shrimp trawl fishery is described, including the different types of gear used. Many vessels now use devices to reduce the by-catch of fish.

The paper summarized the observer sampling that has been carried out since 1996 off the West Coast of Vancouver Island, in Queen Charlotte Sound, and in Chatham Sound. It discussed the observed catch of halibut, the condition of halibut caught, and the fish exclusion devices that some vessels are now using to attempt to reduce the by-catch of fish. Based on observer data and total effort as recorded in logbooks, total catches of halibut were estimated, and presented with their associated estimated 95% confidence limits.

Systematic area-swept surveys of the shrimp grounds off the West Coast of Vancouver Island are conducted on a generally annual basis. Through these surveys, we know that halibut do occur on these grounds. The paper presents the biomass of halibut on these grounds, as estimated from data collected during

these surveys.

By-catch of halibut was only observed in shrimp trawl catches in 1997 and seems to be restricted to vessels fishing otter trawls. A majority of otter trawl vessels are trying to reduce the by-catch impact through the voluntary use of fish exclusion devices, and while these devices do not completely eliminate the halibut catch, they may result in the fish being in better condition when they are released.

Reviewers' Comments

Reviewer 1 noted that this paper is the first to address the by-catch of halibut in shrimp fisheries in Canada and completes the coast wide picture of by-catch (Alaska and southern US states being complete). Reviewer 1 suggested that the authors provide more discussion or provide a reference on the sampling in the observer program. Reviewer 1 questioned the variability in the observer coverage between years. Reviewer 1 found the lack of halibut by-catch observed on the WCVI puzzling as there are halibut in the area and suggested more discussion as to why there is a lack of by-catch from this area.

Reviewer 2 believes mangers and assessment personnel should be applauded for their attempts to address the extremely important issue of by-catch. Reviewer 2 acknowledged the authors' efforts in recognizing the need for accountability of non-target species in a mixed species fishery and felt these aspects of the program should be highlighted

Since the data presented on halibut by-catch supports Canada's treaty obligation to account for all mortality of halibut in Canadian fisheries Reviewer 2 questioned the credibility of the program given the minimum sampling effort. Reviewer 2 suggested including the numbers of individual vessels sampled and asked if the sampling was representative. Reviewer 2 questioned whether the authors believe they have adequate coverage temporally and spatially.

Reviewer 2 suggested that some areas of the program be more fully documented. Further clarification on the fishery, the gear and management of the fishery as it applies to by-catch and halibut was requested. Reviewer 2 suggested more detail on what "exclusion devices" are and how they work. Reviewer 2 also suggested more information be supplied on the methods used in the observer program.

Reviewer 2 provided some editorial suggestions and recommended the use of maps to clarify the distribution of sampling and fishing effort.

Subcommittee Discussion

The Subcommittee wondered whether halibut by-catch was a significant issue in BC shrimp trawl fisheries, given the limited observations of halibut by-catch in

three years of sampling. Several suggestions were made to improve data presentation, including expanded tables and inclusion of figures. The authors felt that the relatively meager data set preclude meaningful analysis into the animal condition categories of good, poor, or dead. The Subcommittee discussed the presence of halibut in research trawl catches, and the apparent lack of halibut in observed commercial catches, and attributed the differences to different criteria for selecting research and commercial trawl locations. After the discussion, the Subcommittee did not feel that there were sufficient data to recommend mandatory use of exclusion devices. The Subcommittee cautioned that results should not be interpreted in such a way to put halibut nursery areas at risk under the assumption that grids will eliminate by-catch. The Subcommittee noted that observer effort was not sufficient to develop absolute estimates. If such estimates are required, additional observer effort is required. The Subcommittee suggested seeking advice from IPHC as to availability of resources and relative importance of estimation of absolute estimates of halibut by-catch from this fishery.

Subcommittee Recommendations

1. The Subcommittee accepted the paper subject to revisions.
2. The Subcommittee recommended examination of the effectiveness of exclusion devices in reducing by-catch in shrimp trawls.

I99-6 Implications on assessment of British Columbia prawn populations with the adoption of a quota management system.

J.A. Boutillier and J.A. Bond **Accepted subject to revisions**

Summary

Industry and fisheries managers have been considering adopting a quota type management system for the prawn fishery in British Columbia. This paper discussed the implications and assessment requirements that would arise as a result of such an undertaking.

The prawn fishery in BC is currently managed to meet two biological objectives: to prevent growth overfishing and to prevent recruitment overfishing. Growth overfishing is controlled through a combination of size limits and manipulation of fishery opening times. Recruitment overfishing is managed using a fixed escapement policy. Implementation of this policy is achieved by inseason at-sea monitory of the fishery CPUE index of spawner abundance, and closures are implemented when the estimated index of spawner abundance falls below a set minimum monthly index.

During the last three years fishing intensity in the prawn fishery has risen dramatically, with the 1998 fishery lasting only 93 days coastwide. It has been suggested that a less intense fishing pattern over a longer period would be

favorable, and managers are now considering the possibility of adopting a quota type system for prawns and abandoning the current fixed escapement framework.

This paper discussed the critical problems and questions that must be answered in order to develop a quota management system, namely determining the population size, determining the spatial scale of the population, and determining how the population responds to exploitation. While there are a variety of methods that may used to address these concerns, many of them may prove difficult to implement for prawns.

The paper concluded that entering into a quota system for prawns would be a very expensive and time-consuming undertaking, considering the data and analytical requirements. Extensive biological sampling would be required, far beyond the level of information that is routinely collected at the present time. To construct a database from which to create the necessary models of the populations' compensatory mechanisms to biological processes such as growth and recruitment would take 15 to 20 years. Since the prawn fishery is data-limited relative to the data demands of a quota system, this would have to be considered a new and developing fishery and strict precautionary principles would have to be imposed.

The problems that the prawn fishery is facing may need to be further examined to determine whether there are alternatives other than a quota management system to address these concerns that would not put the stocks and the fishery at risk.

Reviewers' Comments

Reviewer 1 concluded that the working paper was a thorough and careful analysis of the requirements of moving to a quota system but noted that the perceived benefits of a quota type management system are not addressed in the introduction. Since implications of a change in management strategy depend on an understanding of the current strategy, Reviewer 1 suggested further description and exploration of the limitations of the current strategy. Reviewer 1 noted that a formal cost benefit analysis is lacking.

Reviewer 1 discussed the problems around the attempt to improve the biological reference point by developing a stock-recruitment relationship based on the limited data from Howe Sound. Reviewer 1 noted that the effects of regime shifts in oceanographic conditions probably confound our understanding of the stock-recruit relationship in prawns. Reviewer 1 noted that extrapolating the stock-recruit relationship of Howe Sound to all of B.C. is questionable. Reviewer 1 also discussed the problems associated with the aggregating characteristic of pandalid shrimps and the CPUE index used in the current strategy.

Reviewer 1 noted that it is unfortunate that the scope of the document does not

include other possible strategies like rotation or some other form of spatially explicit management which might require less management resources (but might be expensive in terms of lost fishing opportunity).

Reviewer 2 found the description of the current management and assessment of the prawn fishery incomplete. Reviewer 2 suggested including a general description of prawn biology, an explicit statement on the reasons for considering a change in management and a review of how the current management system is working.

Reviewer 2 found the approaches presented in the working paper to be a logical and adequate treatment for developing a quota based management scheme. Reviewer 2 noted a special case worth considering in the B.C. herring fishery where a fixed exploitation rate is used, except when such a harvest would take the stock below a minimum accepted biomass or cutoff. The exploitation rate drops to zero as the cutoff is approached.

Subcommittee Discussion

The Subcommittee reviewed the questions posed in the original Request for Working Paper and ascertained that all were answered to the extent that current data would allow. The results of the paper indicate that to be risk averse under a quota based system (due to lack of adequate data) would result in much lower yields and would require a much more expensive data collection system. Discussion followed on the depth of recommendations that may be made by the Subcommittee and covered:

1. Consideration of other management systems that may be implemented;
2. Clarification on the implications of a new management system that may better disperse the fishery spatially and temporally;
3. The need for a clear set of questions and problems that have plagued the industry.

Subcommittee Recommendations

The Subcommittee accepted the paper and supported the conclusions. The Subcommittee did not recommend the implementation of a quota program at this time due to expense and limited data availability.

I99-7 Review of the fishery and assessment of green sea urchin stocks in British Columbia.

R.I. Perry and B.J. Waddell **Accepted subject to revisions**

Summary

The working paper (i) reviewed the green sea urchin *(Strongylocentrotus droebachiensis)* fishery in British Columbia since its inception in 1987, with

emphasis on recent years (post-1995); (ii) updated a biomass dynamic model to determine green urchin stock status in British Columbia; and (iii) presented initial results of fishery-independent surveys for green urchins. The green urchin fishery in B.C. developed rapidly from 1987 to 1991, and peaked in 1992 with landings of 1042 t. Declining landings and catch per unit of effort followed and management restrictions were implemented in 1992. In 1995, an individual quota system with dockside validation was implemented. In 1997/98, coastwide landings (all in the South Coast) were 160 t, approximately equal to the quota. The principal Pacific Fishery Management Areas for green sea urchins are 12, 13 (Queen Charlotte and Johnstone Straits) and 18, 19, 20 (Gulf Islands - Juan de Fuca Strait). Harvest logbook information is collected as a condition of license, and verified against quota validation records. Median catch per unit of effort (CPUE) was calculated from the harvest logbook data to provide a robust index of changes in stock size. Analyses are conducted on a fishing season basis (1 October of year i to 31 March of year i+1). Biomass dynamic models were developed for the South Coast - inside waters northern region (PFMA 11,12,13) and South Coast - inside waters southern region (PFMA 17-20,28). Total allowable catches in the range of 35-70% * MSY are recommended to account for uncertainties in the input data and assumptions in the dynamic production models. Recommended yield options for the South Coast range from 201.8-403.9 t. A TAC calculated for PFMA 4 on the North Coast of B.C., based on a fishery-independent survey, is 6.1 t (calculated as a 10% exploitation rate applied to the surveyed biomass). Seven fishery-independent surveys were conducted in a core fishing area of PFMA 12 in eastern Queen Charlotte Strait. The lower 95% confidence bound of the mean annual legal-sized (>55 mm test diameter) biomass for PFMA 11,12,13 from these surveys is similar to the biomass estimated by the dynamic production model. Information from the biomass dynamic model results, fishery-independent surveys, and reports from fishermen suggest that the stock in the South Coast - northern region is relatively abundant with recent good recruitment, whereas the status of the stock in the South Coast - southern region is more uncertain.

Reviewers' Comments

Reviewer 1 thought, overall, that the analyses were sound and that the authors had reached reasonable conclusions based on the supplied data. Reviewer 1 questioned the validity of the landing data from the fishery and asked if harvests by First Nations were significant. Reviewer 1 was skeptical of mathematical estimates of population parameters (r, q, k) from data sources where there could be financial benefit from not being 100% accurate and questioned whether the authors had any independent data from biological observations or experiments that suggest the parameters were appropriate.

Reviewer 1 noted that the ratio of legal to sublegal urchins was higher in B.C. than in New Brunswick, which might suggest sporadic recruitment. Reviewer 1 asked whether sporadic recruitment would affect the model and whether any

ageing studies or juvenile collections are being done to determine recruitment rates and patterns.

Reviewer 2 found the authors had produced a good description of the fishery and a concise, well-written, and thoughtful assessment document. Reviewer 2 agreed with the recommendations made by the authors, given the information available and the precautionary approach taken. Reviewer 2 felt the recommendations provided to mangers were useful with a good connection to the paper but left managers in the difficult position of determining how likely it was that the assumptions of the biomass dynamic model were violated. Reviewer 2 suggested consideration of other, more realistic, models that incorporate variable recruitment for future studies.

Reviewer 2 suggested the authors include the rationale for using the biomass dynamic model. Reviewer 2 recommended that instead of fitting the model using data from combined areas then redistributing the quota back to the areas based on their proportional contribution to the catch, the authors consider fitting to model for each area or treat each area as a dummy variable. Reviewer 2 noted that the partial residual plots and the influential data points should be provided, as they are informative to the fit of the model.

Reviewer 2 requested some explanation of why a model with a low failure and less predictive power works "better" and is more influenced by the fishery than the model that has a higher failure index and a higher predictive power.

Reviewer 2 questioned whether there are any data that could be used to independently estimate catchability or assess whether CPUE is proportional to abundance.

Subcommittee Discussion

The Subcommittee noted that, since 1993 when management measures were implemented, there appears to have been a recovery in some populations. Nonetheless, concern was expressed that the high end of the range of quota options presented to managers was too risky. In justifying the selection of the range of options from 35-70% of MSY, the authors explain that these were taken from the published literature. Since there had been obvious concerns about the health of the green sea urchin stocks which led to management actions in 1993, the Subcommittee supported continuing the rebuilding strategy, even in light of an apparent improvement in some stocks in recent years. The Subcommittee does not support the 70% MSY option. Furthermore, it was felt that even the lowest option of 35% MSY in the southern area might be too high. Exploitation rates in the southern area are roughly estimated to be 3 to 6 times that in the northern beds. Additional lower options will allow managers more flexibility to be conservative. Choosing a lower option is also prudent considering the assumptions of the assessment model. The Subcommittee noted that, even at

the lowest quota option presented (35% MSY), there would be an increase in overall quota.

A number of issues were raised with the CPUE index and whether artifacts of fishing practices had an influence on the CPUE value. In particular, questions were posed of whether fishers are being more selective since the institution of IQ's, whether search time for high quality roe has changed, or whether animals have more time to aggregate than previously. The authors were confident that no significant changes have occurred in the way the fishery is prosecuted since 1995 that would account for the increase in CPUE seen in recent years. They acknowledge that CPUE indices have problems and that they are starting to examine the spatial distribution of effort from harvest logbooks with the view of examining whether spatial expansion has occurred.

The Subcommittee questioned whether the population increase could be attributed to better management or to a recruitment pulse. Size-frequency data from surveys indicate that only in the last two years has a recruitment pulse been evident. The authors argued that the improvement in some stocks is likely due to the decrease in fishing effort.

Subcommittee Recommendations

The Subcommittee accepted the paper subject to minor revisions.

1. The Subcommittee recommended that the option of 70% MSY not be considered by managers and that additional lower options, especially for southern beds of green sea urchins (PFMA's 17 to 20 and 28), be provided to allow for stock re-building.

2. The Subcommittee recommended that limit reference points be considered for this fishery and be attempted in future assessment working papers.

I99-8 Review of Northern, or Pinto abalone, *Haliotis kamtschatkana*, in Canada.

G. Jamieson **Accepted subject to major revisions**

Summary

Jamieson (1989) reviewed the status of Northern, or Pinto, Abalone (*Haliotis kamtschatkana*) in British Columbia, Canada, but while the paper was accepted and reviewed by COSEWIC (Committee on Status of Endangered Wildlife in Canada) in April, 1988, no status could be assigned, as at that time COSEWIC had no mandate for invertebrates. COSEWIC's mandate changed in 1994, however, and COSEWIC is now able to assign status to molluscs. Here, the

author updated the review of the status of this species, and recommended that a status of "threatened" be considered for Northern Abalone.

Reviewers' Comments

Reviewer 1 noted that the purpose of a status report for COSEWIC is to assess a species' status in relation to risk of biological extinction in Canada. Reviewer 1 continues that this could be a significant report for endangered species conservation protocols in Canada and that COSEWIC's expertise in marine molluscs is quite limited, consequently a high quality document is required.

Reviewer 1 requested a section in the paper that summarizes the life history and ecological characteristics of abalone that affect resilience or vulnerability of the animal to the threat of extinction. Reviewer 1 summarized that the main biological question whether this species is at a heightened risk of extinction is whether it is adapted to live successfully at low densities or is it a species that needs to be highly abundant to be successful. Reviewer 1 suggested that the author include information on the situation of other abalone elsewhere. Reviewer 1 cautioned about the uncritical dependence upon abundance declines in assessing whether the species is at risk of extinction.

Reviewer 1 noted that the argument for the recommended designation was fairly weak. The working paper should reflect the risk of biological extinction, not whether there is a poaching problem.

Reviewer 2 felt that the data and arguments presented in the working paper were not adequate to support the conclusions and recommendations of the author. Although Reviewer 2 agreed that the threatened status could be considered by COSEWIC, the support for the recommendation was lacking in the paper.

Reviewer 2 provided several corrections to the description of the abalone fishery and the events that lead to the closure of the fishery. Reviewer 2 suggested the author clarify that the rationale for closure of the abalone fishery was conservation. Reviewer 2 noted that the abalone fishery was the first "new" invertebrate fishery and that no process was in place for the management of a resource for which there was limited data.

Reviewer 2 suggested the author substantiates or removes speculative references.

Reviewer 2 noted that abalone spawning aggregations may contribute significantly to the abalone's vulnerability to harvest and suggests this warrants consideration in the document.

Subcommittee Discussion

The subcommittee reiterated its grave concern for abalone populations, despite the drastic management measures implemented in 1990, as presented in PSARC Advisory Document 98-1. In 98-1 the subcommittee supported that there was no evidence of rebuilding of abalone stocks and that the trend showed continued declines in abalone abundance on the Central Coast. The subcommittee acknowledged the workshop on abalone rebuilding strategies in February 1999 as the beginning of an emphasis on rehabilitative measures for the species as recommended in PSARC Advisory Document 97-2.

The subcommittee noted that this is a precedent setting case of a commercially harvested invertebrate being considered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The Subcommittee acknowledged that, since there has been no significant degradation of abalone habitat, the importance of the biological and life history characteristics of the species is very relevant to a COSEWIC review. The Subcommittee therefore recommended that this background information be given in more detail in the working paper.

The subcommittee concluded that the information and the analysis presented did not provide a scientific basis to support the author's recommendations. Under the COSEWIC "threatened" category, a species is likely to become endangered if limiting factors are not reversed. The Subcommittee questioned whether the limiting factors could, first, be defined and, second, be reversed. Limiting factors may include uncontrolled illegal fishing mortality, expansion of sea otter populations and aspects of abalone life history that inhibit successful recruitment. The implied relationship between sea otters and abalone outlined in the paper is only speculative, as is the magnitude of illegal harvest levels. While there is agreement that these factors exist, there are no data presented. While aspects of abalone biology that pertain to population robustness (for instance patchy distribution and limited larval dispersal) are understood, the number and size of population aggregations or patches that are required to maintain a viable population is unknown.

The question of whether the species is adapted to live successfully at low densities under high predation pressure is an important one but, unfortunately, the abalone population size prior to the extirpation of sea otters is unknown. There are some indications that populations of abalone can persist at low levels of abundance for several decades (e.g. red abalone in California).

Subcommittee Recommendations

The Subcommittee recommended acceptance of the paper only after major revisions presented by the reviewers and discussed in the meeting.

FISHERY UPDATES

Fishery updates are summaries of the performance of commercial fisheries prepared annually by fishery managers in consultation with (C&P) Conservation and Protection and Stock Assessment. The Invertebrate Subcommittee uses fishery updates to identify assessment and conservation concerns in each fishery.

The Subcommittee compared the Fishery Update format with the new framework for Integrated Fisheries Management Plans (IFMP's). The Subcommittee concluded that all information presented in the Fishery Updates was relevant to IFMP's (if not an exact duplication). Therefore the Subcommittee recommended that the format for Fishery Updates be revised to match the framework for IFMP's. This should assist in the development of IFMP's by reducing duplication of effort. The Subcommittee recognized the value of annual consideration of each fishery by the Subcommittee and suggested that annual submission of fishery updates continue even if IFMP's become multi-year plans.

Shrimp Trawl Fishery Update

License limitation occurred in the shrimp trawl fishery in 1978. Prior to 1997 the fishery was largely unregulated. In response to large increases of effort in the fishery in 1995 and 1996, a management program was implemented in 1997 with the establishment of Shrimp Management Areas and precautionary catch ceilings for most of these areas (based on a percentile of historic effort, or an arbitrary precautionary level). Catch monitoring, stock assessment and catch sampling programs were developed. A portion of the costs associated with managing the fishery was recovered from industry through a Treasury Board Submission. The fishery is data limited.

Of 248 vessels eligible to fish in the 1998/99 season, 187 vessels participated. A preliminary landed value for the 1998/99 season was estimated at $5.8 million. This effort is at the high end of the range of historic effort prior to the unprecedented effort seen in 1995 and 1996 (216 and 222 active vessels, respectively). The number of active vessels from 1982 to 1994 ranged from 102 to 190. The number of single 'S' licenced vessels has increased as a result of buy backs of salmon licences. In 1995 there were 6 single 'S' licensed vessels. In 1997 this changed to 67 single 'S' licensed vessels. This indicates increased effort to the fishery, and an increased economic reliance on the fishery.

Initial area catch ceilings for the 1998/99 season were adjusted in-season if information from stock assessment surveys indicated a total allowable catch for

the area that was either greater than, or less than, the initial arbitrary catch ceiling. These surveys contributed a significant increase in fishing opportunity over the initial levels (a 54% increase). Although the fishing season has not yet finished, and is operating under the new management regime, the landings from the shrimp trawl fishery in 1998/99 are higher than historic landings prior to 1995. Unprecedented landings were recorded in 1995 and 1996.

The Subcommittee noted that the shrimp trawl fishery continues with the active management that began in 1997, and acknowledged the effort required to complete assessment surveys and in-season management actions.

Goose Barnacle Fishery Update

The goose barnacle fishery is not actively managed. Licenses are not limited and management is currently restricted to a few local area closures. The fishery is small (<15 tonnes annually since 1995) and recent declines in the fishery have been attributed to the problems with shipping live product to the primary market in Spain. The quality of the harvest data has continued to decline in the goose barnacle fishery. The Subcommittee reiterated the position that data limited fisheries and unregulated fisheries must follow the phased approach for developing fisheries.

Shrimp Trap Fishery Update

The Shrimp by Trap fishery is limited to 257 licenses and is managed to a minimum escapement estimate of the spawning cohort of prawns. Other management measures include the use of trap limits, a minimum size limit, trap mesh requirements to permit escapement, and hail requirements to assess effort in season. This competitive fishery is approaching full exploitation as only a few remote and/or offshore prawn stocks are not fully utilized. Other shrimp species caught by trap are not actively managed.

Landing weight in the 1998 shrimp trap fishery was comparable to that of 1996 and 1997, and was the third highest on record. A slight increase in landings from North Coast areas was noted. However, landed value in the fishery decreased 30% from 1997 levels as a result of a decline in the Japanese economy. Price per kilogram for medium grade frozen-at-sea (FAS) prawns dropped from $13.20 to $9.22, and for large grade prawns dropped from $19.80 to $14.17. In contrast, live and fresh product value exceeded FAS product value in some instances. The live and fresh product represents a very small portion of the total landings (<5%).

Effort in the fishery has historically been measured by number of trap hauls per vessel per season. This method was reviewed in 1998 and trap hauls are underestimated. A table and figure was developed to describe weight of catchper vessel day of fishing. This figure has doubled since 1991. The length of

the fishing season has declined from 230 days in 1994 to 93 days in 1998.

Industry has funded a spawner index and trap limit monitoring program since 1995 ($400K in 1998). Eleven charter patrol vessels were contracted for the 1998 fishing season. Charter patrolmen played an enforcement role until June 1998, and an ORR function for the remainder of the season.

Priority issues following the 1998 fishery were to investigate:
1. the possibility of establishing a individual vessel-based quota fishery;
2. the potential impacts of the growing recreational fishery;
3. the impacts of multiple trap hauling in a single day;
4. the combined effects of a weak Japanese economy and a short fishing season; and
5. possible options for funding the fishery after 2001.

Neon Flying Squid Fishery Update

The fishery for neon flying squid began as a three year pilot in 1996. A maximum of six vessels participated in the fishery since its inception. The Subcommittee noted that the fishery made it's first significant landings (70 tonnes) in 1998 after a slow start. A number of revisions are required to the fishery update for neon flying squid to meet the current format and to accurately describe the inception of this new offshore fishery.

Red Sea Urchin Fishery Update

The commercial red sea urchin fishery is managed with area quotas and size limits. The coastwide quota is divided equally among the 110 licenses into individual quotas. Individual quotas are monitored through the use of industry funded dockside validators and at-sea monitors. Two percent of the coastwide total allowable catch is reserved for First Nation's food, social and ceremonial purposes. The Subcommittee recognized the priority issue of evaluation the impacts of commercial fisheries on the ability of First Nations to access red sea urchins for food, social and ceremonial purposes, especially in the Queen Charlotte Islands.

The Subcommittee discussed fishing mortality that is not captured in the validated weights of red sea urchins. Urchins are broken during harvest either while being removed from the substrate or to check gonad quality. No estimate of this mortality is available.

The Subcommittee suggested that the text and footnotes to the tables include a description to clarify the changes in CPUE with the change in management to individual quotas.

Euphausiid Fishery Update

The trawl fishery for euphausiids was limited to 18 vessels in 1993, however active participation has been much less annually (e.g. 12 vessels participated in 1997.) The euphausiid fishery is limited to a 500 tonne quota. Expansion of this quota is not expected. The Subcommittee noted that 1998 was the first year that the fishery reported any by-catch. The amount of by-catch was small (< 1%) and was attributed to the availability of euphausiids to the gear. This availability problem also resulted in a slow fishery that did not reach the quota.

Appendix 1 PSARC Invertebrate Subcommittee Meeting Agenda, 25-28 January 1999.

Time	25 January	26 January	27 January	28 January
08:30-09:00	Introductions	FU: Shrimp Trawl	Review Raporteur's Report (day 2)	FU: Red Sea Urchin
09:00-09:30	I99-1: Cal. Mussels	I99-4: Shrimp Trawl	I99-7: Green Sea Urchin	FU: Euphausiid
09:30-10:00	Review I99-1	Review I99-4 Discussion	Review I99-7	Discussion
10:00-10:15	Break	Break	Break	Break
10:15-11:00	Discussion	I99-5: Halibut By-catch	Discussion	Shrimp SSR
11:00-11:30	I99-2: Sea Mussels	Review: I99-5	I99-8: Abalone	Prawn SSR
11:30-12:00	Review I99-2	Discussion	Review I99-8	Discussion
12:00-13:00	Lunch	Lunch	Lunch	Lunch
13:00-13:30	Discussion	FU: Prawn	Review I99-8	Goose Barnacle SSR
13:30-14:00	FU: Goose Barnacle	I99-6: Prawn	Discussion	Discussion
14:00-14:30	I99-3: Goose Barnacle	Review I99-6	I99-9: Crab	General Business
14:30-14:45	Break	Break	Break	Break
14:45-15:30	Review I99-3	Discussion	Review I99-9	Review Raporteur's Report (day 3)
15:30-16:00	Review I99-3	Discussion	Discussion	Cont'd.
16:00-16:30	Discussion	Review Raporteur's Report (day 1)	Crab SSR	General Business
16:30-17:00	Discussion	Cont'd.		

Appendix 2: PSARC Invertebrate Working Papers for January 1999.

Number	Title	Authors	Reviewers
I99-1	A review of California mussel *(Mytilus californianus)* fisheries biology and fisheries programs	Schmidt, D.	Gillespie, G Morin, S.
I99-2	Stock assessment and management frameworks for the proposed fishery for sea mussels *(Mytilus californianus)* in British Columbia	Gillespie, G.	Yamada, S. Bourne, N.
I99-3	A review of the biology and fisheries of the goose barnacle *(Pollicipes polymerus* Sowerby, 1833)	Lauzier, R.	Austin, B. Parker, G.
I99-4	Evaluation of a new assessment and management framework for west coast shrimp Stocks	Boutillier, J. Bond , J. Nguyen, H.	Koeller, P. Fargo, J.
I99-5	Halibut by-catch in the British Columbia shrimp trawl fishery	Boutillier, J. Bond, J. Nguyen, H.	Joyce, M. Williams, G.
I99-6	Implications on assessment of the British Columbia prawn populations with the adoption of a quota management system	Boutillier, J. Bond, J.	Bishop, G. Tanasichuck, R.
I99-7	Review of the fishery and assessment of green sea urchin stocks in British Columbia.	Perry, I. Waddell, B.	Godbout, L. Robinson, S.
I99-8	Review of status of Northern, or Pinto abalone, *Haliotis kamtschatkana*, in Canada	Jamieson, G.	Adkins, B. Powles, H.
I99-* Withdrawn	Size frequency analysis and instar determination in Clayoquot Sound and Fraser River delta Dungeness crab (*Cancer magister*)	Jamieson, G. Lessard, J. Phillips, A. Smith, B.	Kronlund, A. Hankin, D.

Appendix 3: Participants at Invertebrate Subcommittee Meeting, January, 1999.

Subcommittee Chair: Ivan Winther
PSARC Chair: Max Stocker

DFO Participants	Mon	Tues	Wed	Thurs
* Subcommittee Members				
G. Parker*	✓	✓	✓	
B. Adkins*	✓	✓	✓	✓
L. Marshall	✓	✓	✓	✓
J. Rogers*	✓	✓	✓	✓
R. Harbo*	✓	✓	✓	✓
M. Kattilaloski*	✓	✓p.m.	✓	✓
C. Hand*	✓	✓	✓	✓
L. Barton	✓	✓	✓	✓
P. Menning	✓	✓	✓	✓
R. Mylchreest*	✓			
K. West*	✓	✓	✓	✓
A. Phillips*	✓	✓	✓	✓
J. Bond	✓	✓	✓	✓
G. Workman	✓	✓	✓	✓
W. Hajas	✓	✓	✓	✓
G. Gillespie*	✓	✓	✓	✓
D. Clark	✓	✓	✓	✓
Z. Yang Zhang	✓	✓	✓	
J. Boutillier*	✓	✓	✓a.m.	
R. Lauzier*	✓	✓	✓	✓
S. Morin	✓a.m.	✓	✓	
E. Wylie	✓	✓	✓	✓
L. Convey	✓	✓	✓	✓
D. Pezzack*	✓	✓	✓a.m.	✓
N. Bourne	✓a.m.			
A. Kronlund	✓a.m.			
B. Waddell*		✓	✓	
J. Burns		✓		
B. Koke*		✓	✓	
D. Hay		✓		
J. Morrison*		✓		✓p.m.
H.Nguyen		✓		✓
G. Jorgenson		✓	✓	
A. Sinclair		✓a.m.		

A. Campbell*		✓	✓	
R. Webb*		✓		
R. Tanasichuck		✓p.m.		
G. Jamieson*			✓a.m.	
B. Lucas			✓a.m.	
L. Godbout			✓a.m.	
I. Perry*	✓	✓	✓	✓

External Participants:

H. Holmes	✓	✓	✓	✓
N. Sloan		✓p.m.	✓	✓
T. Orr		✓p.m.		
G. Johnson		✓p.m.		
L. Clayton		✓a.m.		
D. Schmidt	✓a.m.			